DYNAMIC BRAKING OF ASYNCHRONOUS ELECTRIC DRIVE WITH SOFT START WHEN POWERED PULSATING CURRENT

I. Golodny, Y. Lavrinenko, A. Toropov

In modern drives are widely used soft starters, for example, a series SSW6. Specifications that are contained in the catalog data on the device, provide little information on the transition to electric modes, especially braking. The article is devoted to the study of power series thyristor block device SSW6 during dynamic braking of asynchronous motor.

The purpose of research - the study of power series thyristor block device SSW6 during dynamic braking of asynchronous motor.

Materials and methods of research. Analysis of instantaneous values of voltage and current of the power semiconductor device unit smooth start was based on the theory of electric drive and power electronics and oscillograms.

Results. In systems with electric device of smooth start series SSW dynamic braking rectified pulsating current in circuits implemented with additional contactor KM2 (Fig. 1) and without it. In the absence of additional contactor mode thyristor formed the scheme described in the literature.

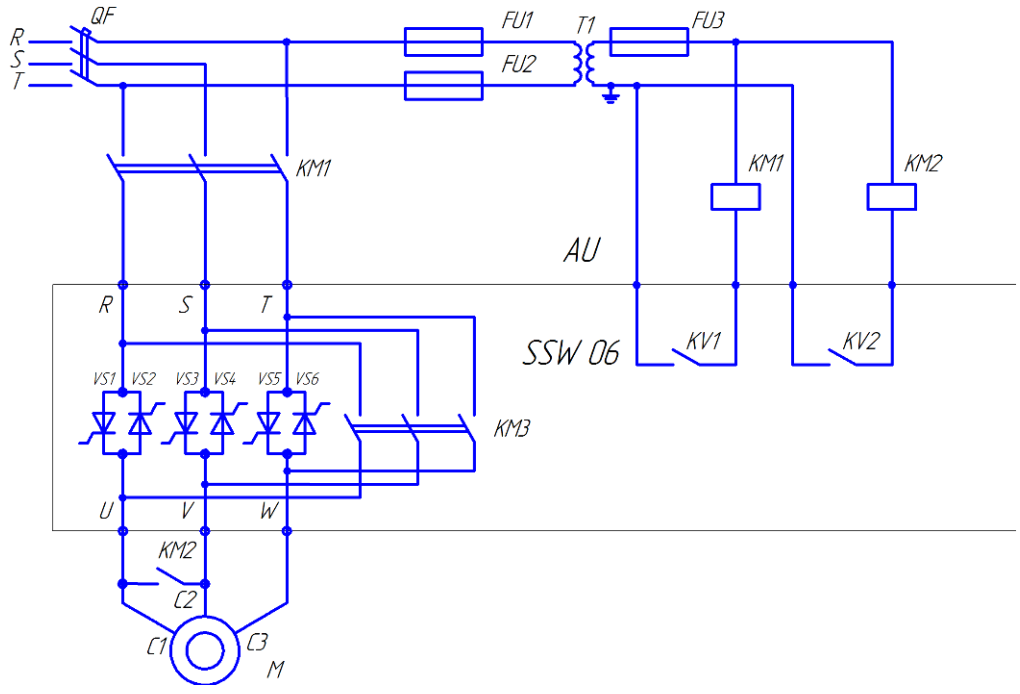

Fig. 1. The scheme switching device of smooth start with dynamic braking constant pulsating current

When a command to stop the engine in soft starters AU (Fig. 1) with a time delay relay contact closes KV2, resulting in fires contactor KM2, which is their main contact zakorochuye terminals C1 and C2 engine M. Bypass contactor km3 off.

With this switching scheme, unlike the classic three-phase rectifier, a combination of keys VS2-VS3 i VS4-VS1 unacceptable.

There are two algorithms supply control pulses to thyristors. In the first case in the first phase of the power unit AU device with a small angle opening in each cycle a direct thyristor, and the third - the reverse. Output voltage waveform are the same as in Fig. 3 and 4, but the current flowing through the motor windings increases. When using the optional two contactor coils are connected in parallel, ie current braking increases is:

$$I_{ГД} = \frac{U_{СЕР.ППП}}{R_{ОБМ.S} + \frac{R_{ОБМ.S}}{2}} = \frac{2U_{СЕР.ППП}}{3R_{ОБМ.S}},$$

where USER.PPP - the average output voltage of the device of smooth start; ROBM.S - phase stator resistance.

Another algorithm supply control pulses complicated. Impulse voltage to the motor windings formed by a combination of keys VS1-VS6 and VS3-VS6 (Fig. 1). When a control pulse to thyristor VS1 VS3 also open, but as potential voltage phase in higher than in phase A, the braking current will create a linear voltage UVS, under current in thyristor VS1 fall to zero and it closes. It should be noted that the minimum opening angle of thyristors must be at least 60 electrical degrees. Thyristor VS1 and VS3 direct and VS6 - reverse and the output will be formed unipolar pulses. By analogy with the method of dynamic braking without locking contactor [1] curves rectified voltage and current by EMF induction motor areas also appear negative polarity (Figure 2).

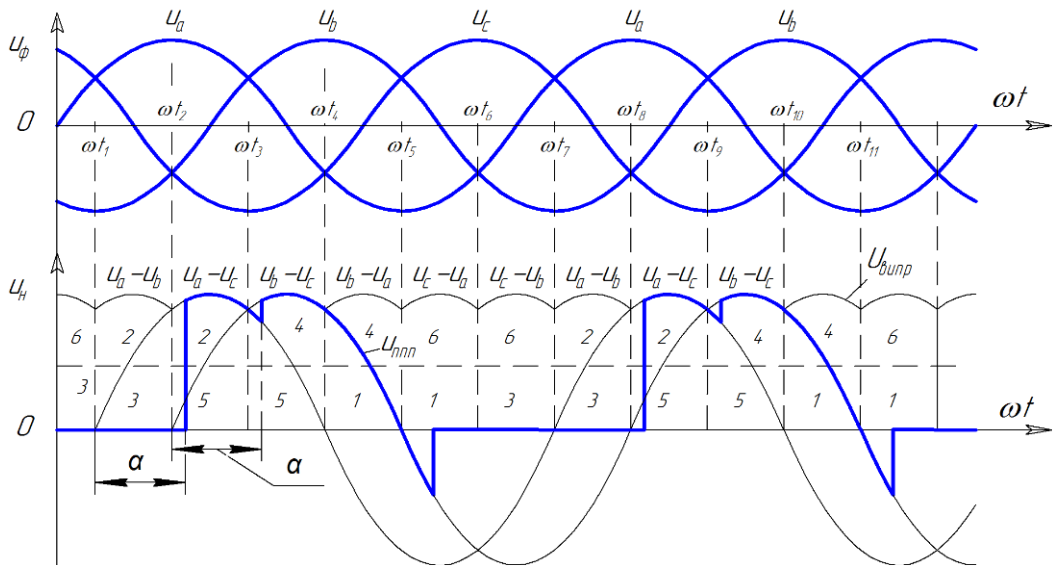

Fig. 2. Graphs of the instantaneous values of voltage formed at the output device of smooth start during dynamic braking

Thus, the stator winding is applied pulsating DC voltage, but in contrast to the case without contactor ripple current are reduced significantly because the pulses wider, and the intervals between them smaller. Under the influence of this current in the stator windings creates a real magnetic field through which there stopping point. The working point of "electric-working machine" moves from the working area of the mechanical characteristics of one propulsion mode for curve 2 or 3 dynamic braking mode (Figure 3). After stopping the engine switches off KV2 and thyristors are closed.

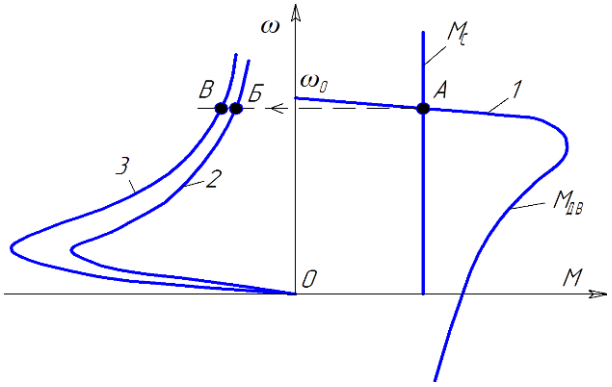

Fig. 3. Mechanical induction motor mode engine (1) and dynamic braking mode (2 and 3):

MDV, MS - mechanical characteristics, respectively, motor and actuator

The magnitude of braking torque, and thus inhibition and duration, changing the angle regulating opening thyristors or braking duty cycle pulse current (Fig. 4). The values given braking torque when debugging the device smooth start, remembering that it is limited to the maximum permissible current braking.

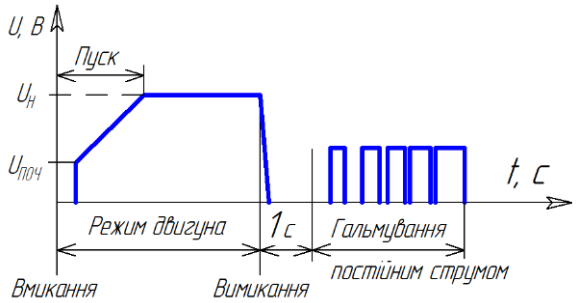

Fig. 4. The supply voltage of the electric work with dynamic braking

This method of braking can be used in circuits with two thyristors in each phase of the power unit block smooth start. Its use is effective at vysokoinertsiynyh engine load medium and large capacities.

The disadvantages of dynamic braking mode pulsating current are:

- need for external contactor KM2 (Fig. 1);
- small braking moment at low speeds;
- inability to use in circuits connecting the motor windings triangle with an internal connection keys.

Conclusions

1. Use external contactor for zakorochuvannya two motor windings during dynamic braking reduces ripple current and the braking point.
2. Created pulses of constant voltage, compared to the version without zakorochuvannya motor windings, broader, and the intervals between them smaller.
3. Similar to the dynamic brake contactor without closing a rectified voltage curve by EDS engine also contains areas of negative voltage polarity.